

LOW-GRADE ASTROCYTOMA ASSOCIATED WITH ABSCESS FORMATION: CASE REPORT AND LITERATURE REVIEW

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A rare case of low-grade astrocytoma associated with abscess formation occurred in a 52-year-old man presenting with Broca's aphasia. He underwent craniotomy and tumor removal under the impression of brain tumor with necrotic cystic change. Abscess accumulation within the intra-axial tumor was found intraoperatively. Literature related to brain abscess with brain tumor is reviewed, with an emphasis on abscesses with astrocytoma. We discuss the common brain tumors that are associated with abscess, pathogens that coexist with brain tumor, and the pathogenesis of coexisting brain abscess and tumor. It is very important to know how to differentiate between and diagnose a brain abscess and tumor, or brain abscess with tumor, preoperatively from clinical presentation and through the use of computed tomography, conventional magnetic resonance imaging, diffusion-weighted imaging or magnetic resonance spectroscopy.

Key Words: astrocytoma, brain abscess, magnetic resonance spectroscopy
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Low-grade astrocytomas are slow-growing astrocytic neoplasms with a high degree of cellular differentiation. These lesions generally affect young adults and have a tendency to progress to higher-grade astrocytomas [1–3].

Brain abscess is the most common infectious lesion and can be caused by many different types of pathogens, usually bacteria. Brain abscesses frequently arise secondary to hematogenous dissemination of an extracranial site, by direct extension from a contiguous suppurative focus, or secondary to meningitis [4,5].

Abscess formation within a brain tumor is uncommon. Astrocytoma with abscess is extremely rare. Intracellar or parasellar tumors are among the most common neoplasms that develop such a complication as the result of direct extension of microbial flora from contiguous infected sinuses [6]. We present a rare case of low-grade astrocytoma associated with abscess formation.

CASE PRESENTATION

A 52-year-old man had underlying diseases including non-insulin dependent diabetes mellitus and hepatitis B virus-related cirrhosis. He could understand what people said but had difficulty with speech for 10 days. He had no history of fever, trauma or hypertension. Physical examination revealed jaundice. Neurologic



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examination revealed Broca's aphasia. Hematologic examination and biochemistry demonstrated coagulopathy, hyperbilirubinemia and thrombocytopenia, but no leukocytosis or elevated C-reactive protein.

Under the impression of cerebrovascular disease, computed tomography (CT) scan was performed. Noncontrast CT demonstrated a left temporal hypodense lesion with perilesional edema (Figure 1A), and contrast-enhanced CT demonstrated mild hyperdense soft tissue components with mild enhancement in the left temporal lobe (Figure 1B). Magnetic resonance imaging (MRI) demonstrated a mass lesion in the left temporal lobe with hyperintensity on T2-weighted images and hypointensity on T1-weighted images. After the administration of contrast medium, the lesion showed a thickened, enhanced wall (Figure 2). Diffusion-weighted imaging (DWI) demonstrated hyperintensity and apparent diffusion coefficient (ADC) revealed hypointensity. Brain abscess was suspected according to the DWI findings (Figure 3). Magnetic resonance spectroscopy (MRS) showed decreased *N*-acetylaspartate (NAA, 2.0 ppm) and creatinine (Cr, 3.0 ppm), elevated choline (Cho, 3.2 ppm), and prominent lipid peak (1.3 ppm) at the lesion (Figure 4), which led to a diagnosis of glioblastoma or metastatic brain tumor.

The patient received surgery under the impression of a brain tumor with necrotic cystic change. Craniotomy and removal of the temporal mass were performed. During the operation, yellow-grayish material

flowed out from the center of the tumor. Pathology of the tumor revealed World Health Organization Grade II astrocytoma (Figure 5) and culture revealed oxacillin-sensitive *Staphylococcus aureus*. Due to the accidental finding of brain abscess, antibiotic therapy with oxacillin and cefepime were given. After treatment, the patient was discharged without any speech disorder.

DISCUSSION

We present a rare case of low-grade astrocytoma associated with abscess formation. This patient received surgery under the impression of a brain tumor with necrotic cystic change. During operation, a brain abscess within the tumor was found accidentally. The pathology of the tumor demonstrated low-grade astrocytoma and the culture of the abscess revealed oxacillin-sensitive *S. aureus*. The definite diagnosis of this patient was low-grade astrocytoma with abscess formation.

We reviewed previous literature related to brain tumors with abscess. Intracranial neoplasms containing abscesses were first described by Asenjo in 1950 [6]. There are few reported cases of abscesses within brain tumors; most are within pituitary tumors [7–10]. Intraseptal or parasellar tumors are among the most common neoplasms that develop such a complication, as the result of direct extension of microbial

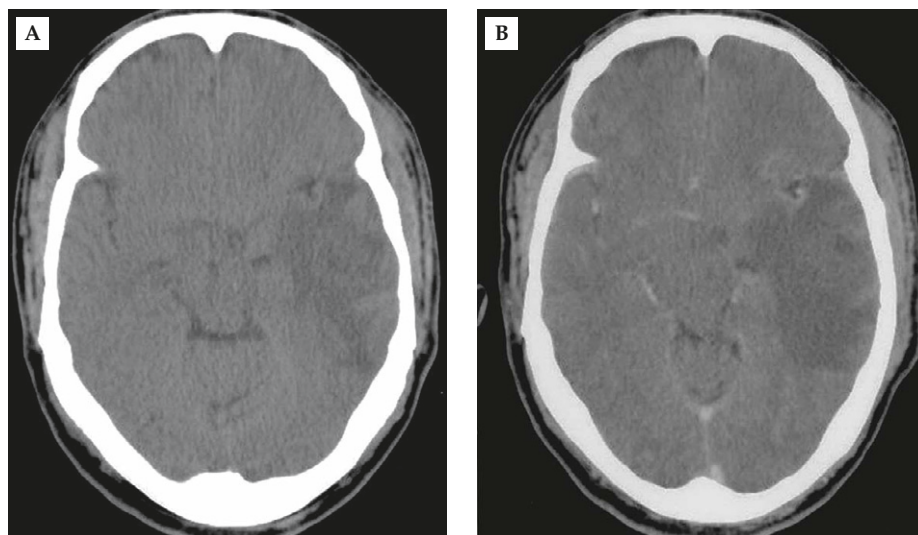


Figure 1. (A) Noncontrast computed tomography demonstrates left temporal hypodense lesion with perilesional edema. (B) Contrast-enhanced computed tomography demonstrates mild hyperdense soft tissue components with mild enhancement in the left temporal lobe.

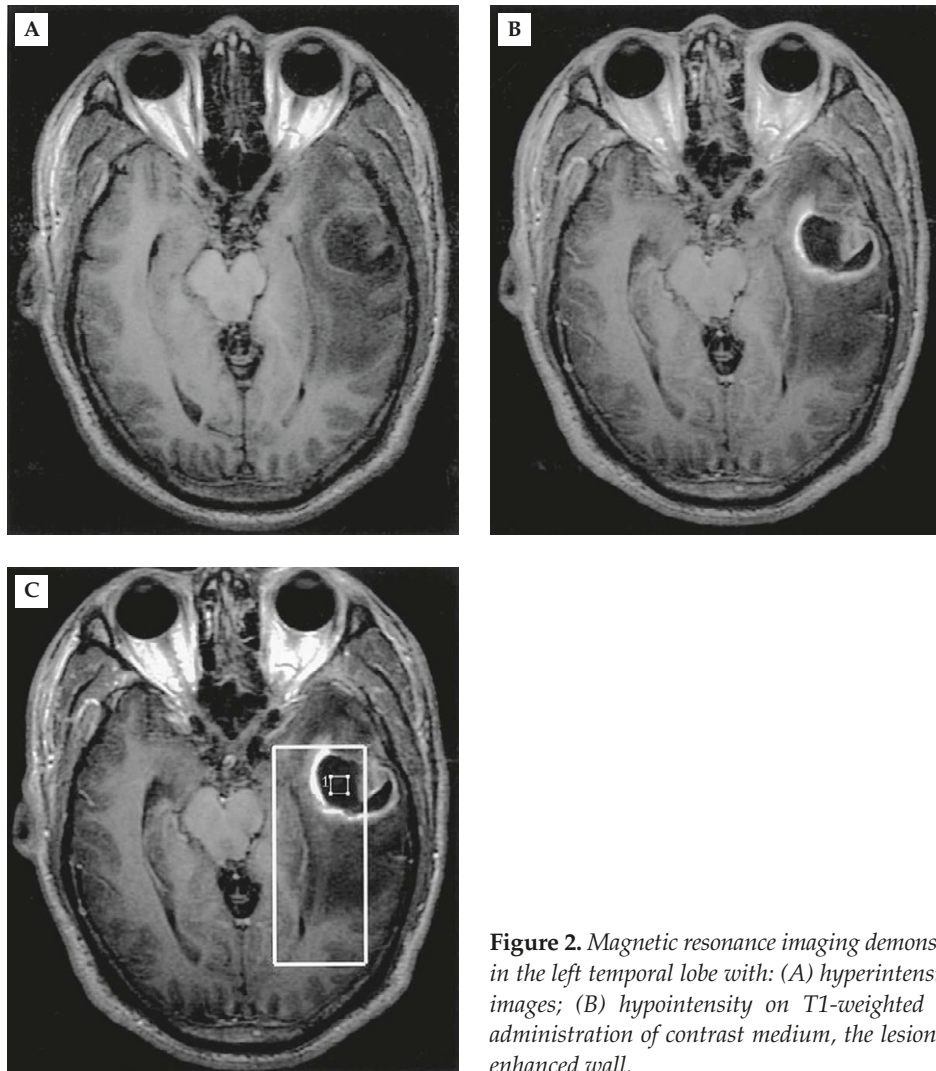


Figure 2. Magnetic resonance imaging demonstrates a mass lesion in the left temporal lobe with: (A) hyperintensity on T2-weighted images; (B) hypointensity on T1-weighted images. (C) After administration of contrast medium, the lesion shows a thickened enhanced wall.

flora from the sinuses [6]. Hatiboglu et al reported a pituitary abscess with adenoma [10]. Pituitary abscess secondary to an adenoma is rare. Only 19 cases have been reported. Craniopharyngioma with abscesses were first described by Riser in 1956 [6]. Few cases of abscess within a craniopharyngioma have been reported [9,11,12].

There are few reported cases of abscess within an intra-axial tumor such as glioblastoma multiforme [9], astrocytoma [6,13], ependymoma [6,14], and medulloblastoma [6]. Mohindra and Gupta reviewed two cases of glioblastoma with abscess [6]. Noguerado et al reported an abscess within a glioblastoma multiforme first and Ichikawai et al presented a rare case of abscess within a glioblastoma as well [9]. Bansal et al reported a child with a right parieto-occipital astrocytoma [13]. Two cases of brain abscess with astrocytoma were reported. At present, our case is the third

case of low-grade astrocytoma with abscess. There are few reported cases of abscess within an extra-axial tumor, most within meningioma [14–20]. Shimomura et al were the first to report a case of meningioma with abscess formation [15]. Five cases of meningioma with abscess have been reported to date [14–20]. A few cases of abscess with brain metastasis have been reported [13,21,22].

We reviewed the literature on cases of low-grade astrocytoma with abscess. Two such cases have been reported (Table 1). Bansal et al described a child with a right parieto-occipital astrocytoma. Histopathologic examination showed a tumor composed of astrocytic cells. This abscess was seen in tumor areas. The pus was teeming with Gram-negative bacilli and showed heavy growth of *Pseudomonas aeruginosa* [13]. Mohindra and Gupta presented a case of a midline posterior fossa tumor with abscess [6]. Histopathology revealed many

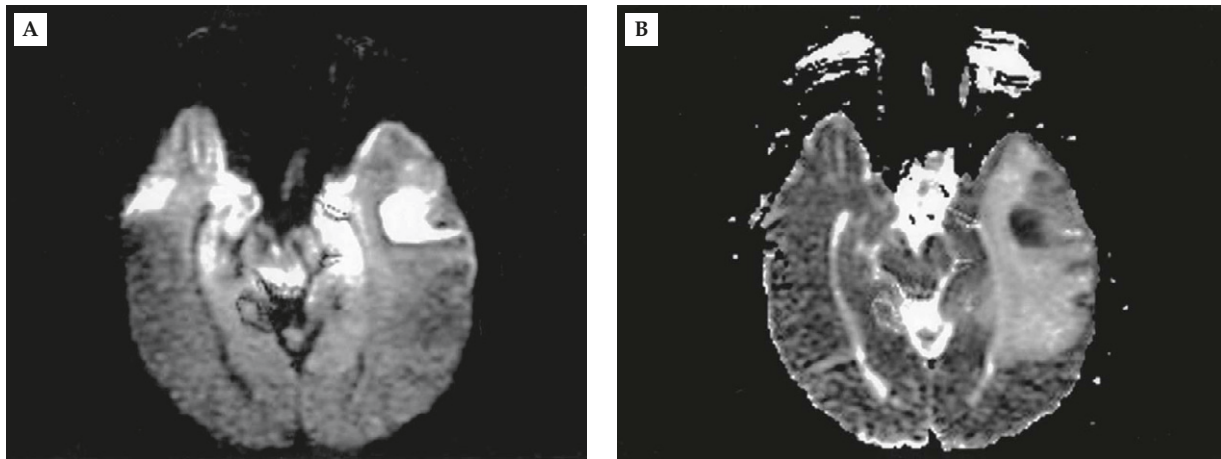


Figure 3. (A) Diffusion-weighted imaging shows hyperintensity; (B) apparent diffusion coefficient reveals hypointensity.

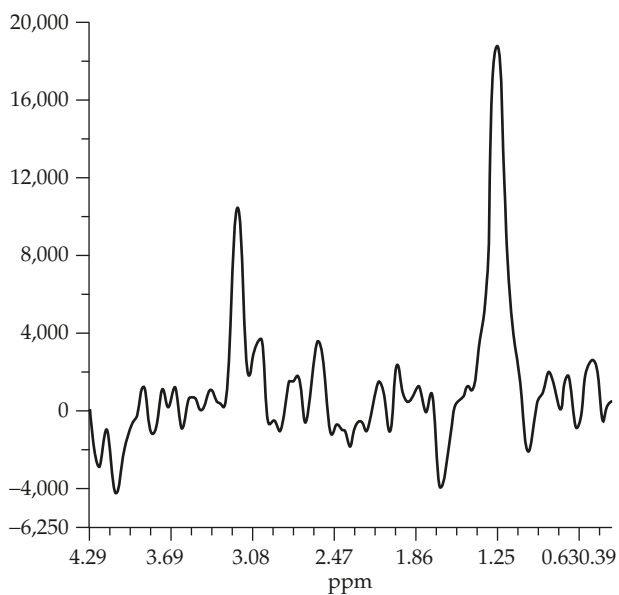


Figure 4. Magnetic resonance spectroscopy reveals decreased *N*-acetylaspartate and creatine, elevated choline, and prominent lipid peak at the lesion.

inflammatory cells interspersed in a low-grade tumor with glial differentiation, suggestive of a low-grade astrocytoma containing an abscess [6]. We also present a rare case of low-grade astrocytoma associated with abscess formation. The pathology of the tumor revealed WHO Grade II astrocytoma, and the culture of the abscess was positive for oxacillin-sensitive *S. aureus*.

The pathogenesis of brain tumors with abscesses is thought to be related to multiple reasons, such as destruction of the blood–brain barrier, fenestration of vessels, tumor bleeding with hematoma, and hormonal imbalance [7,9,15]. First, disruption of the blood–brain

barrier and fenestration of vessels by brain tumors are important in the development of abscess. Second, tumor bleeding with hematoma acting as a culture medium is important in the development of an abscess as well. Glioblastoma, which has no blood–brain barrier, and the nutritious hematoma within the tumor, may induce metastatic abscess by sepsis [9]. Meningioma may also cause fenestration of vessels and destruction of the blood–brain barrier such as a metastatic brain tumor and glioblastoma [15]. Third, chronic hormonal overstimulation is the pathogenesis of pituitary adenoma with *Toxoplasma gondii* infection [7].

The immune system and the blood–brain barrier play important roles in resisting bacterial infection. Immunocompromised patients are at risk for brain abscess. Brain abscess can be attributed primarily to immunodeficiency and secondarily to various immunosuppressive agents that are used in aggressive cancer treatment and organ transplantation [4,5]. Destruction of the blood–brain barrier by a brain tumor is also a factor in the development of brain abscess. Analyzing the pathogenesis of the brain abscess with tumor, our patient had hepatitis B virus-related cirrhosis (Child-Pugh Class A). The immune system of the patient was compromised and the blood–brain barrier may have been destroyed by the tumor. Brain abscess associated with tumor may occur in immunocompromised patients with destruction of the blood–brain barrier by the tumor.

Brain abscess may be caused by aerobic, anaerobic, Gram-positive and Gram-negative bacteria. What is the common pathogen of abscesses with tumors? We summarize the previous pathogens of cerebral abscess

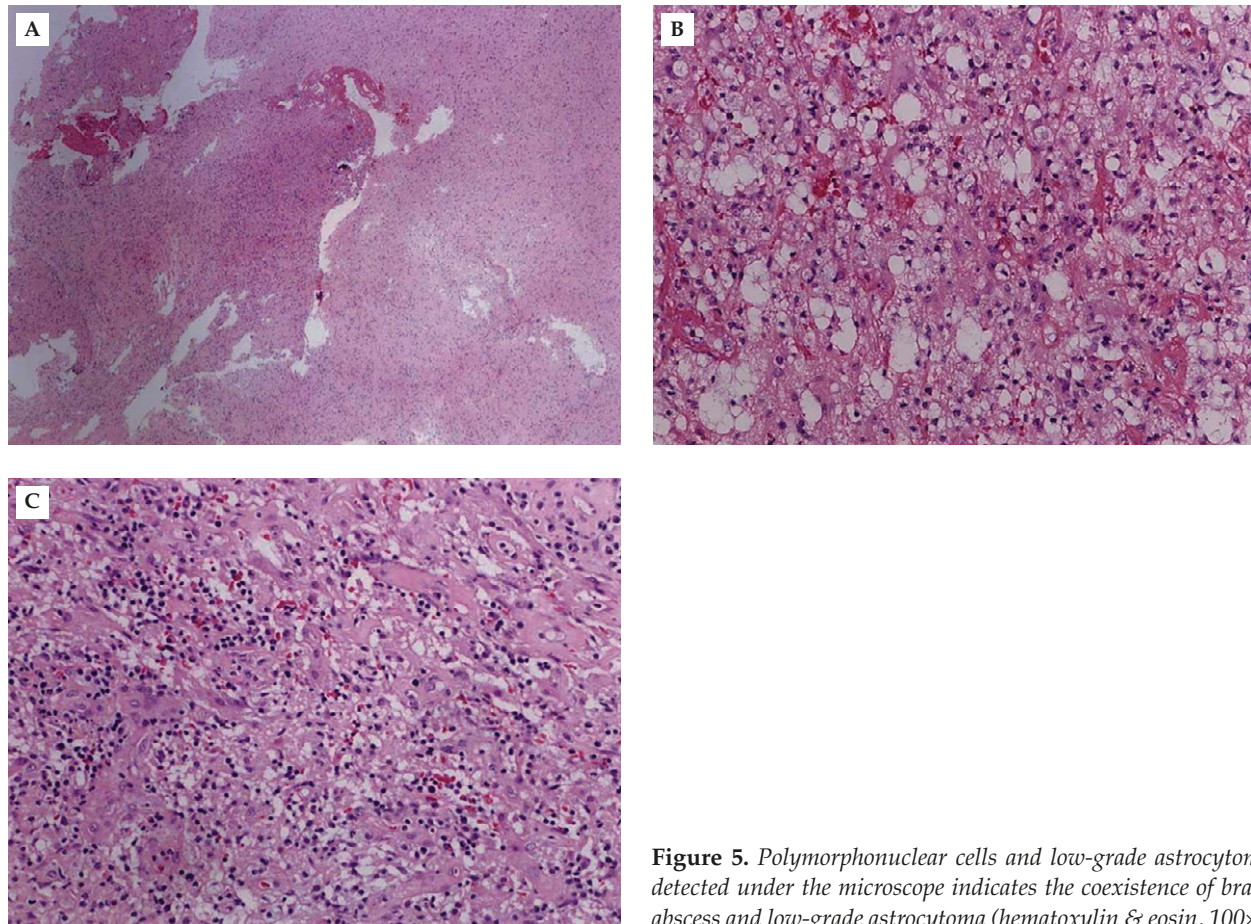


Figure 5. Polymorphonuclear cells and low-grade astrocytoma detected under the microscope indicates the coexistence of brain abscess and low-grade astrocytoma (hematoxylin & eosin, 100 \times).

with brain tumor and emphasize abscesses with intra-axial brain tumors in Table 2. The data indicate that *S. aureus* was the most common organism in intra-axial tumors. The findings of our case are consistent with these results. This indicates that homogeneous spread is the pathogenesis of abscesses with intra-axial tumors.

Brain abscesses and tumors are usually diagnosed on the basis of findings from CT and MRI, together with clinical presentation [23]. However, early diagnosis of brain abscess and brain tumor remains challenging. It is more difficult to diagnose brain abscesses associated with tumors. DWI and ADC have recently shown promise in differentiating ring-enhancing lesions such as a brain abscess and malignant neoplasm [23,24]. MRS has also been widely applied in differentiating ring-enhancing lesions such as brain abscess and malignant neoplasm [23,24]. Combined proton MRS and diffusion-weighted MRI were used to establish the preoperative diagnosis of brain abscess and tumor [23].

Previously reported experience with DWI, hyperintensity within the central portion of a ring-enhancing mass on DWI and a low ADC suggest cerebral abscess [24]. In our case, DWI demonstrated hyperintensity and ADC revealed hypointensity. According to DWI, brain abscess over the left temporal lobe was highly suspected. On MRS, the presence of lactate cytosolic amino acids with/without succinate, acetate, alanine and glycine can be regarded as a marker for abscess, and lactate and choline for nonabscess cases [23]. In our patient, MRS revealed decreased NAA and Cr, elevated Cho, and prominent lipid peak at the lesion, which were initially thought to be compatible with the usual findings for metastatic brain tumor or glioblastoma. Owing to the finding of DWI and MRS, we could not differentiate brain tumor and abscess or coexisting tumor with abscess preoperatively.

In summary, we presented a rare case of astrocytoma associated with abscess formation. We discussed the common brain tumors that are associated with abscess, pathogens that coexist with brain tumors, and

Table 1. Astrocytoma with abscess

Author	Age (yr)/sex	Symptoms & signs	Systemic disease	Location	Tumor grade	Organism	Prognosis
Bansal et al [13]	11/F	Left focal seizure	None	Right parieto-occipital lobe	Low-grade astrocytoma	<i>Pseudomonas aeruginosa</i>	Died
Mohindra & Gupta [12]	35/M	Diffuse headache, projectile vomiting, diminution of vision, drunken gait, difficulty in swallowing and nasal intonation to voice	None	Midline posterior fossa	Low-grade astrocytoma	None	Fully independent
This case	52/M	Anomic aphasia	Liver cirrhosis	Left temporal lobe	WHO Grade II astrocytoma	<i>Staphylococcus aureus</i>	Fully independent

Table 2. Pathogen of brain abscesses with intra-axial tumors

Pathology	Pathogen
Glioblastoma	<i>Staphylococcus aureus</i> [5]
Ependymoma	<i>Enterobacter aerogenes</i> [22]
Astrocytoma	<i>Pseudomonas aeruginosa</i> [15] <i>Staphylococcus aureus</i> (this case)
Brain metastasis (lung carcinoma)	<i>Propionibacterium acnes</i> [17]
Brain metastasis (unknown origin)	<i>Staphylococcus</i> species [17]

the pathogeneses of coexisting brain abscesses and tumors. It is very important to understand how to diagnose brain abscess and tumor, or brain abscess with tumor, preoperatively, based on clinical presentation and findings from CT, MRI, DWI or MRS.

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星狀細胞瘤伴隨腦膿瘍的發生 — 病例 報告以及文獻回顧

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一位 52 歲男性因失語症發現右側腫瘤，術前診斷為疑似腦膿瘍或者是囊狀壞死性腦腫瘤接受手術，手術中意外發現膿瘍存在，術後診斷為星狀細胞瘤伴隨腦膿瘍，回顧文獻星狀細胞瘤伴隨腦膿瘍發生的病例相當罕見。回顧以往有關於腦腫瘤合併腦膿瘍以及星狀細胞瘤合併腦膿瘍發生的文獻，我們討論有關於常見會發生腦膿瘍的腦腫瘤、以及常見致病菌以及發生的機制，重要的是是否可以經由臨床症狀、電腦斷層掃描、傳統的核磁共振、核磁共振光譜，在術前鑑別診斷是腦腫瘤、腦膿瘍或者腦腫瘤合併腦膿瘍。

關鍵詞：星狀細胞瘤，腦膿瘍，核磁共振光譜

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